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Report on the Performance of the Arthabaska Recycling Centre

Report EPS 3/CE/1
June 1991

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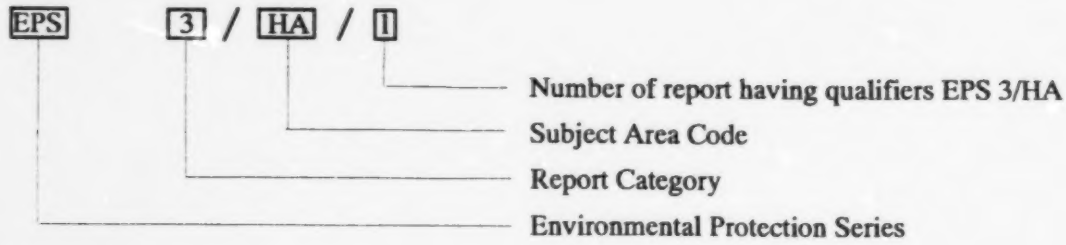

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Think Recycling!

Pensez à recycler !

This publication is printed on paper containing recovered waste.

Report on the Performance of the Arthabaska Recycling Centre

by

Claude Michaud BSc, MEnv.
The Steica Group, Environmental Engineering, and Urban-planning Consultants
4300, boulevard Bourque
Rock Forest, Quebec
J1N 2A6

for the

Technology Development Branch
Environmental Protection
Conservation and Protection
Environment Canada

This project was conducted under the Development and Demonstration of Resource and Energy Conservation Technology (DRECT) Program

Report EPS 3/CE/1
June 1991

91-05844/

CANADIAN CATALOGUING IN PUBLICATION DATA

Michaud, Claude, 1965-

Report on the performance of the Arthabaska Recycling Centre

(Report ; EPS 3/CE/1)
Issued also in French under title: Étude sur le rendement du Centre de tri d'Arthabaska.
Includes an abstract in French.
"This project has been carried out under the Development and Demonstration of Resource and Energy Conservation Technology Program (DRECT)."
Includes bibliographical references.
ISBN 0-662-18896-9
DSS cat. no. En49-25/3-1E

1. Recycling (Waste, etc.) -- Quebec (Province).
2. Recycling industry -- Quebec (Province).
3. Refuse and refuse disposal -- Quebec (Province).
I. Canada. Environment Canada. II. Canada. Technology and Technical Services Branch.
III. Title. IV. Title: Development and Demonstration of Resource and Energy Conservation Technology Program. V. Series: Report (Canada. Environment Canada) ; EPS 3/CE/1.

TD794.5M52 1991 628.4'458'09714 C91-098655-X

©Minister of Supply and Services Canada 1991
Cat. No. En 49-25/3-1E
ISBN 0-662-18896-9

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Comments concerning this report may be addressed to:

S.A. Ross
Technology Development Branch
Conservation and Protection
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Abstract

As part of Environment Canada's Development and Demonstration of Resource and Energy Conservation Technology Program (DRECT), the Centre de tri Gaudreau Inc., a recycling centre, was provided financial aid to develop a method of sorting recyclable materials recovered from household waste.

The Centre de tri Gaudreau Inc. serves approximately 23 350 pickup points, or 58 100 individuals, spread out over an area of 774 km^2 (density: 75 people per square kilometre). The company collects unsorted recyclable materials from residences, then does all the sorting at the centre. In 1988 and 1989, the amount of material recycled was the same (5 500 t/yr, or 20.7% of the 26 600 tonnes of waste generated in the region Gaudreau serves). Approximately 70% of the population participated in the recycling program.

Initially, households had to partially sort recyclable materials before collection, now Gaudreau Inc. collects the materials unsorted. Changes made at the centre following this change in collection procedure resulted in decreased collection costs from 1988 to 1989, but increased processing costs at the centre. Overall, expenditures were slightly higher in 1989 than in 1988. Positive changes made at the centre, however, have made the collection and sorting operations independent of each other; stabilized operating costs; allowed the centre to offer a higher quality of recyclable materials on the market; and ensured better use of materials.

A sharp drop in the market price for recovered materials, however, caused the annual operating deficit to rise from $1.67 per pickup point in 1988 to $4.76 in 1989 (statistics based on a 7-month period). For this business to be profitable, therefore, a greater financial contribution from the representative municipalities will be necessary.

Résumé

Dans le cadre du Programme de création et de démonstration de techniques de conservation des ressources et de l'énergie (DRECT) supervisé par Environnement Canada, le Centre de tri Gaudreau Inc. a reçu un montant d'argent pour établir une technologie de tri des matériaux recyclables récupérés de rebuts ménagers.

Le Centre de tri Gaudreau Inc. dessert environ 23 350 portes, soit 58 100 personnes, sur un territoire de 774 km^2 (75 habitants par km^2). La collecte résidentielle des matières recyclables est de type mélangé, et tout le tri s'effectue au Centre. En 1988 et en 1989, la quantité de matières recyclées est demeurée la même, 5 500 t/a, soit 20,7 % des 26 000 t de déchets produits sur le territoire. Le taux de participation de la population est d'environ 70 %.

Les modifications apportées au Centre de tri faisaient suite au passage de la collecte semi-triée à la collecte mélangée des matières recyclables. Ainsi, les frais de la collecte ont diminué de 1988 à 1989, tandis que les frais d'usine ont augmenté pour porter le total des dépenses à un niveau légèrement supérieur à celui de 1988. Cependant, la baisse marquée des prix sur le marché de vente des matières récupérées a fait passer le manque à gagner des opérations de 1,67 $ la porte par année en 1988 à 4,76 $ la porte par année en 1989 (statistiques fondées sur une période de sept mois). Ainsi, la rentabilisation de l'entreprise devra passer par une reconnaissance financière accrue des municipalités. Les réaménagements apportés au Centre ont toutefois permis de rendre la collecte indépendante du tri, de stabiliser les frais d'opération, d'offrir une qualité de matières recyclables supérieure sur le marché et d'améliorer l'écoulement des matières.

Table of Contents

Abstract v
Résumé vi
List of Figures ix
List of Tables ix
Acknowledgments x

Section 1
Introduction 1

Section 2
Basic Statistics 2
2.1 Region Served and Number of Pick-up Points 2
2.2 Residents' Role in Recycling 2
2.3 Method of Determining Amount of Waste Generated . 3

Section 3
The Bellevue Experiment 5

Section 4
Description of the Existing System 9
4.1 Collecting Recyclable Materials 9
4.2 Collecting and Landfilling Garbage 9

Section 5
The Gaudreau Recycling Centre 10
5.1 Site Description 10
5.2 New Equipment and Renovations 10
5.2.1 Materials Handling System 10
5.2.1.1 Receiving 10
5.2.1.2 Sorting 12
5.2.1.3 Compacting 13
5.2.1.4 Crushing glass 13
5.1.2.5 Scrap generation 13
5.2.1.6 Storing and shipping recyclables 14
5.2.2 Staff and schedule 14

Section 6
Amount and Value of Materials Recycled 15
6.1 Output of the Recycling Centre 15
6.2 Production and Sales of Each Type of Material Under Current Market Conditions 15
6.2.1 Textiles 15
6.2.2 Newsprint 15

6.2.3 Black and White Paper, White Paper, and Coloured Paper **20**
6.2.4 Mixed Paper **20**
6.2.5 Corrugated Cardboard **21**
6.2.6 Kraft Paper **21**
6.2.7 Aluminum **21**
6.2.8 Metal Food Cans **21**
6.2.9 PET Plastic **21**
6.2.10 Granulated Plastic and Post-consumer Plastic **22**
6.2.11 White and Green Glass **22**
6.3 Amount of Materials Recycled and Discarded by the Centre in 1989 ..... **22**
6.4 Processing Capacity of the Centre **22**

Section 7
Economic Analysis **23**
7.1 Recommendations for Improving RBF's Profitability **27**
7.2 Comparison with Other Selective-collection Systems **28**

Section 8
Environmental Analysis **30**
8.1 Environmental Benefits **30**
8.2 Energy Savings **30**

Section 9
Conclusion and Recommendations **31**

References **33**

Appendix **35**
Drawings
1. **Layout Before New Installations**
2. **Layout After New Installations**

List of Figures

1	Area served by Récupération Gaudreau Inc.	3
2	The Bellevue Experiment	7

List of Tables

1	Number of Pick-up Points, Population, and Area of Municipalities Served by Récupération Gaudreau Inc.	2
2	Amounts of Waste Generated in the Area Served by Récupération Gaudreau Inc.	3
3	The Bellevue Experiment - Quantity of Non-recyclable, Compostable, and Recyclable Materials Collected	6
4	Equipment Installed and Renovations Made at Gaudreau Recycling Centre	11
5	Material Recovered in 1988	16
6	Material Recovered in 1989	16
7	Sales of Recovered Materials in 1988	18
8	Sales of Recovered Materials in 1989	18
9	Sales Prices of Materials Recovered in 1988 and 1989	20
10	Amount of Materials Recycled and Discarded in 1989	22
11	Financial Analysis for 1988 and 1989	24
12	Summary of Financial Analysis for 1988 and 1989	26
13	Comparison of Three Recycling Organizations in Quebec	29
14	Energy Saved Through the Use of Materials Recovered by the Centre	30

Acknowledgments

The authors wish to express their thanks to the Centre de tri Gaudreau Inc. and especially to Daniel Paul and Daniel Gaudreau, for their exceptional co-operation, and to Margot Beauchênes and Jean-Guy Boutin, without whom this study could not have been carried out with the resources available.

This study was made possible through financing from Environment Canada's Development and Demonstration of Resource and Energy Conservation Technology Program (DRECT), which paid for the new equipment at the centre. We also wish to thank the scientific staff, Francine Laperrière, Gérald Girouard, and Richard St-Germain, and especially Gervais Leclair, who enabled us to complete this study.

Finally, the authors wish to acknowledge the considerable efforts of Normand Maurice as the main founder of Récupération Bois-Franc Inc.

Section 1

Introduction

The purpose of this study is to assess the actual operational improvements and economic impact of implementing a model waste recycling centre in a medium-sized municipality. The recycling facility is located in Arthabaska Quebec and was formerly owned by Récupération Bois-Franc Inc. (RBF). During the project, the centre was purchased by the local garbage-collection company, Gestion Gaudreau Inc., and given a new name, Centre de tri Gaudreau Inc.

Récupération Bois-Franc Inc., however, continued to carry out the activities for which it was originally established: providing information and training regarding recovery and recycling. Récupération Bois-Franc Inc. was founded in May 1977 by the students and faculty of the Victoriaville secondary school, under the direction of Normand Maurice, the main founder. The group sought to address a clear and obvious problem: "Our current way of life will cause resources to become depleted within 50 years, and the wastes we are discharging are toxic to the environment in varying degrees. We must therefore try to re-use raw materials."

In 1984, RBF was able to get selective collection of recyclables included in the garbage-collection contract for the cities of Victoriaville, Arthabaska, and Sainte-Victoire. Subsequently, this service was extended to all 12 municipalities in the Bois-Francs region.

At first, residents were required to sort their recyclables before collection, separating glass, paper, aluminum, and other materials. The collection trucks were equipped with separate compartments so that these materials could be stored separately. Since the end of 1988, however, when collection was turned over to the private sector, residents have been able to place all their recyclables in one container. The trucks collect the various types of materials without separating them. In conjunction with this new collection system, changes were made at the recycling centre. These changes are the subject of this report.

Section 2

Basic Statistics

2.1 Area Served and Number of Pick-up Points

Gaudreau Inc. collects recyclable materials in 12 municipalities in the Bois-Francs region, which comprises about 23 350 pick-up points. The region has an area of 774 km^2 and a population of 58 100. Table 1 shows the numbers of pick-up points, the population, and the area of each municipality separately.

The population density of this region is 75 inhabitants per km^2. In comparison, the Montreal Urban Community and the City of Laval have virtually the same area as Bois-Francs (775 km^2), but a population of 2 036 746. This represents a population density of 2628 inhabitants per square kilometre, 35 times greater than the Bois-Francs region.

Figure 1 shows this region and its location within the Province of Quebec.

2.2 Residents' Role in Recycling

The residents served by Récupération Gaudreau Inc. place all recyclable materials in blue plastic bins for collection. These materials are picked up at the same time as regular garbage. In addition, containers have been placed at four locations in the area so

Table 1 Number of Pick-up Points, Population, and Area of Municipalities in the Bois-Francs Region

Municipality	No. of Residential Pick-up Points	No. of Commercial Pick-up Points	Population	Surface Area
Victoriaville	9 508	800	21 587	17.01
Arthabaska	2 854	190	7 244	8.92
Sainte-Victoire	2 345	300	6 038	54.59
Warwick	1 050	120	2 807	3.41
Warwick Canton	931	27	2 002	110.60
Plessisville	2 428	161	7 042	4.44
Plessisville (parish)	830	75	2 723	136.29
Princeville	1 370	112	3 905	3.41
Princeville (parish)	1 069	40	1 706	195.21
Saint-Christophe	611	22	1 894	74.87
Sainte-Élizabeth	127	NA*	394	50.51
Chesterville	231	10	741	114.89
Total (rounded)	23 350	1 860	58 100	774

* NA: not available

Figure 1 **Bois-Francs Region**

that people can drop off recyclables at their convenience.

In 1987, a study subsidized by the Fonds de récupération québécois (FRQ) indicated that 70% of residents in the serviced area were participating in the recycling program. This figure was based on a 10-year experience with recovery and recycling in the region, and is used for calculating response rates in the subject project.

2.3 Method of Determining Amount of Waste Generated

To determine the percentage of materials recovered from a municipal waste stream, it is necessary to first establish the quantity of waste generated. This information is not available in the Bois-Francs region because the wastes are not weighed when they arrive at the landfill sites.

To obtain actual data on the total amount of waste generated would require a detailed study. For the purpose of this project, three earlier studies were used to estimate the amount of waste generated in the region:

- Statistics for the city of Montreal (Morissette, 1989) show an average daily production of 1.1 kg per person, including commercial pick-ups.
- Figures for the city of LaSalle (Graige, 1988) show an average daily production of 0.69 kg per person, in strictly residential neighborhoods.
- Roche (1985) showed that for the province of Quebec as a whole, the average daily production of municipal waste is 1.13 kg per person; the actual amount varies from 0.44 to 1.51 kg, depending on the population and the proportions of household and commercial waste.

An analysis of the results from these studies allowed the amount of waste generated per person to be estimated. In Table 2, the municipalities are divided into two categories. For the more urban municipalities with a high proportion of commercial waste, a figure of 1.3 kg per person per day was used. For the rural municipalities with a low proportion of commercial waste, a figure of 0.9 kg per person per day was used.

Table 2 Amount of Waste Generated in the Bois-Francs Region

Municipality	Estimate of Amount of Waste		Amount of Waste Generated	
	kg/person · d^{-1}	t/person · d^{-1}	(t)	population
High Proportion of Commercial Waste: Victoriaville Arthabaska Sainte-Victoire Warwick Plessisville Plessisville (parish) Princeville	1.3	0.475	24 364	51 346
Low Proportion of Commercial Waste: Warwick Canton Princeville (parish) Saint-Christophe Sainte-Elizabeth Chesterville	0.9	0.330	2 213	6 736
		Total: (rounded)	26 600	

Section 3

The Bellevue Experiment

To demonstrate that up to 60 percent of the wastes generated in a residential neighbourhood can be diverted from the landfill, Normand Maurice of RBF and Récupération Gaudreau Inc. are conducting a one-year experiment in the Bellevue district of Arthabaska. A sampling of the results (September to November 1989) are presented in this section.

Specifically the project involves a collection system that segregates recyclable, non-recyclable, and compostable materials. To make this possible, each household has been supplied with two closed plastic containers mounted on wheels: a 360-L container for non-recyclables and a 240-L container for recyclables. Compostable materials are placed in clear plastic bags. The three types of materials constitute the total waste.

The recyclable and non-recyclable materials are picked up on Tuesdays, the compostable materials on Fridays. All three components of the waste are weighed. The non-recyclables go to the Saint-Louis landfill site, the recyclables (glass, paper, metal, plastic) go to the Gaudreau recycling centre, and the compostable materials (grass, leaves, and garden trash) go to the Sainte-Elizabeth de Warwick agrobiology development centre, where they are composted.

Bellevue is a residential neighbourhood of 518 single-family homes. Approximately 1 500 residents are targeted in the project.

As indicated in Table 3, the first three weeks of the experiment marked an adjustment period during which the amount of compostable materials collected increased while the amount of non-recyclables decreased. It appears that people were not used to separating these two types of materials and it took some time to make the adjustment. In contrast, the amount of recyclable materials did not fluctuate at the start of the experiment. The residents were already familiar with the process of separating recyclables from non-recyclables. Figure 2 presents these data graphically.

By the eighth week, compostable and recyclable materials accounted for 68.9% of the total weight of waste collected. This period corresponded to the peak time for collection of dead leaves.

The Bellevue project has shown that a large proportion of municipal waste can be diverted from the landfill if compostables (i.e., garden wastes, dead leaves) are separated from non-recyclables. Pickup throughout the area served by Récupération Gaudreau Inc. could yield approximately 1 800 t of compostable materials in October alone. Data from the Bellevue project indicate that if compostables were collected from May through October, up to 6 500 t of these material could be diverted from the landfill (i.e., For the period from May through September, when there are no dead leaves, an average of 10 kg of compostable material may be generated per residence per week. The October data is added, giving a total of 6500 t of compostable materials). This figure represents 25% of the total amount of waste generated in the region studied. Recyclables (generated at a rate of approximately 5.4 kg per home per week), represent another 6 500 t of materials diverted from the landfill. A total of 13 000 t, or 50% of the total amount of waste produced, therefore, could be diverted from the landfill each year.

Table 3 The Bellevue Experiment - Quantity of Non-recyclable, Compostable, and Recyclable Materials Collected

Month	Week	Wastes/ Total	Non-recyclable Materials		Compostable Materials		Recyclable Materials			Total Compostable + Recyclable	
		(kg)	kg	%	kg	%	kg	%*	%**	kg	%
September	1	15 364	11 262	73.3	1 220	7.9	2 882	18.8	20.4	4 102	26.7
	2	17 864	10 410	58.3	4 400	24.6	3 054	17.1	22.7	7 454	41.7
	3	17 864	8 820	49.4	6 270	35.1	2 774	15.5	23.9	9 044	50.6
	4	17 564	8 720	49.6	5 290	30.1	3 554	20.2	29.0	8 844	50.4
	5	16 854	8 850	52.5	4 486	26.6	3 518	20.9	28.4	8 004	47.5
October	6	17 082	8 350	48.9	5 954	34.9	2 778	16.3	25.0	8 732	51.1
	7	19 152	7 340	38.3	8 764	45.8	3 048	15.9	29.3	11 812	61.7
	8	25 900	8 060	31.1	14 910	57.6	2 930	11.3	26.7	17 840	68.9
	9	20 728	6 970	33.6	10 970	52.9	2 788	13.5	28.6	13 758	66.4
November	10	11 102	6 220	56.0	2 094	18.9	2 788	25.1	31.0	4 882	44.0
	11	9 882	6 480	65.6	374	3.8	3 028	30.6	31.8	3 402	34.4
	12	7 884	5 270	66.8	0	0.0	2 614	33.2	33.2	2 614	33.2
	13	7 534	5 410	71.8	0	0.0	2 124	28.2	28.2	2 124	28.2
	14	7 934	5 500	69.3	0	0.0	2 434	30.7	30.7	2 434	30.7
Total		212 708	107 662	50.6	64 732	30.4	40 314	19.0	27.2	105 046	49.4
Mean		15 193	7 690		4 624		2 880			7 503	
Standard Deviation		5 325	1 783		4 379		361			4 506	

* recyclable materials/total amount of waste
** recyclable materials/(total amount of waste - compostable materials)

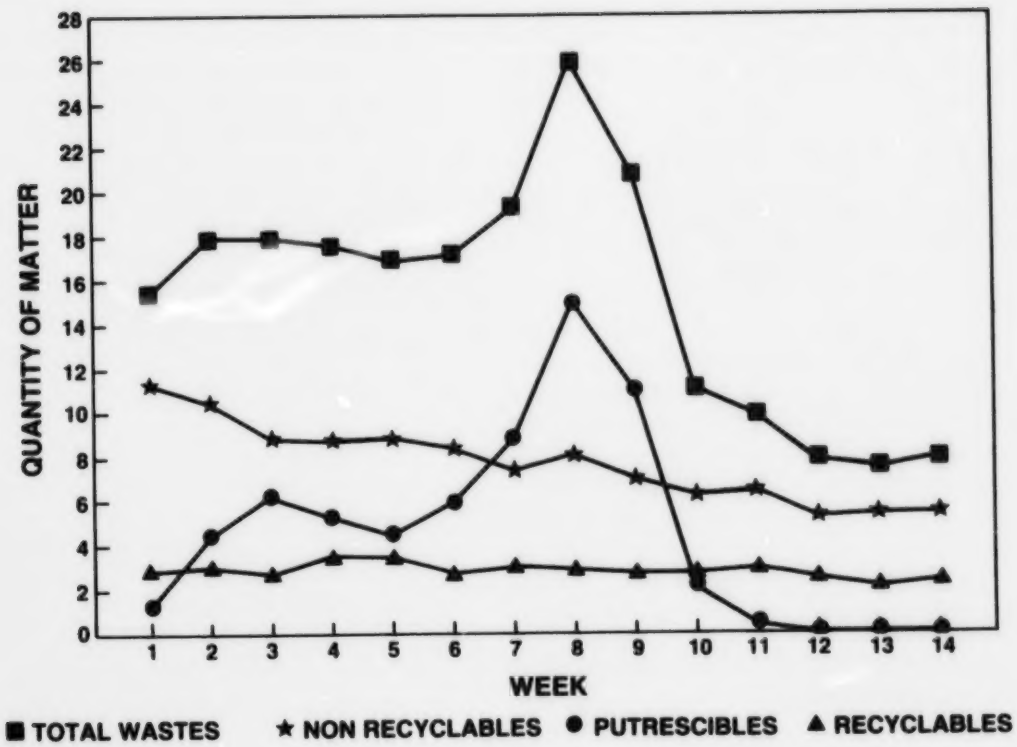

Figure 2 **The Bellevue Experiment**. Results for the first 14 weeks of separate collection of non-recyclable, compostable, and recyclable materials in the Bellevue district of Arthabaska. (Period covered: 1 September to 30 November 1989. Approximate number of homes: 500. Approximate number of residents: 1 500. Results are shown for each category separately and for all categories combined.)

The plastic bags used to hold the compostable materials in the Bellevue project created problems for the composting operation. In order to get a good finished product, these bags should be opened and removed. A method must be provided for separating the plastic bags from the compostable materials at the time of collection.

Section 4

Description of the Collection System

4.1 Recyclable Materials

Prior to 1 November 1988, recyclable materials were collected by RBF using trucks with two separate compartments: one for paper and cardboard, the other for glass, cans, and aluminum. After the acquisition of the recycling centre by Gestion Gaudreau Inc., it was no longer required to separate recyclables before pick-up. These materials are now collected by three, single-compartment, side-loading trucks. The work schedule is from 5:00 AM to 1:00 PM, and each truck picks up an estimated average of 5 to 6 tonnes of recyclable materials per day. The pattern of deliveries to the recycling centre, however, is irregular. Since 1988, this pattern has been:

Day of week	Number of truck deliveries per day
Monday	3
Tuesday	5
Wednesday	7
Thursday	5
Friday	1 (first and second Fridays of the month only)

Cardboard is collected from businesses in two ways:

- A compactor truck covers a route five days per week and returns to the recycling centre once per day with about 2 to 2.5 tonnes of cardboard.
- A roll-off truck collects dumpsters from about 70 businesses and delivers eight dumpsters to the centre each week, with a total of about 4 tonnes of cardboard.

Deposit beverage containers made of glass, aluminum, and polyethylene terephthalate (PET) are delivered to the centre by the bottlers.

4.2 Non-recyclable Materials

Most of the municipal solid waste (MSW) collection in the Bois-Francs region is loaded into side-loading trucks.

The waste in the area receiving selective-collection service is taken to the Saint-Louis landfill. The exception is the municipality of Plessisville. About 3 300 t of the MSW from Pleissisville is taken to Notre-Dames-de-Lourdes in the Regional Municpality of l'Erable.

The amount of waste landfilled at the Saint-Louis landfill is estimated to be 48 500 t per year, of which 21 100 t comes from the area served by the recycling centre. The Saint-Louis landfill was enlarged in the summer of 1989. Its theoretical lifetime has been extended to 30 years. The cost of landfilling one tonne of MSW will increase to $18 or more (possibly as much as $25 or $30) as a result of this work. Prior to 1989, the tipping fee at the Saint-Louis landfill was $12/t.

Section 5

The Gaudreau Recycling Centre

5.1 Site Description

The Gaudreau recycling centre is located on a 2 230 m^2 (22 000 ft^2) lot in an industrial area. The building has a total area of 1 300 m^2 (14 000 ft^2), of which 560 m^2 (6 000 ft^2) is used for storage and 718 m^2 is used for the recycling centre's operations. The remaining 22 m^2 (240 ft^2) is used for the centre's administrative offices. There is also a garage on the site, measuring about 100 m^2 (1 100 ft^2). Formerly, this garage housed a repair shop for the centre's vehicles and equipment. But since November 1988, the repair shop has been moved into the main building. The garage is now used for storing vehicles in winter. Eventually this space will be used for testing new technologies.

5.2 New Equipment and Renovations

The purpose of the project discussed in this report was to enable the centre to accept mixed recycled materials, to optimize the current sorting procedure, and to improve the quality of the final product. For this purpose, various physical improvements were made in the materials-processing system. The cost of renovations and suggestions for additional improvements that would enhance the process further are listed in Table 4.

5.2.1 Materials Handling System

Two drawings of the plant layout are found in the Appendix of this report. The first, entitled "Layout before new installations", shows the centre as it was at the end of 1988. The second, "Layout after new installations", shows the centre in November 1989, after the renovations had been made and the new equipment had been installed.

5.2.1.1 Receiving. The collected materials are unloaded outside the building near the door next to the receiving area. In good weather, the materials can be left outside for some time, but in the winter or when it is raining, they are brought inside immediately. In September 1989, the receiving area was enlarged (Item 9 in Table 4) so that materials could be handled more efficiently when they first arrive.

A small front-end loader is used to push the materials into the building, where a fork-lift places them into a receiving bin. This bin represents the starting point of the sorting line for recyclables collected on the residential route.

Plans not included in the current project call for the construction of a receiving pit, into which trucks could directly unload their contents. The pit would replace the receiving bin and eliminate the need to handle the material with a front-end loader and fork lift.

Another planned modification for the receiving area not included in the current project is the installation of a perforated rotating drum. This equipment would remove small particles such as broken glass and sand from the process stream thus reducing the risk of injury to workers and damage to downstream sorting equipment.

Cardboard from commercial clients is unloaded directly into the building through the rear door near the compactor. The cardboard is pushed onto a dolly and transferred by conveyor to the compactor, where it is compacted and baled.

Deposit containers (aluminum cans, plastic (PET) bottles, and glass containers) are

Table 4 Equipment Installed and Renovations Made at the Gaudreau Recycling Centre

Item*		Cost of Purchase ($)	Cost of Installation ($)	Equipment Commissioning ($)	Possible Future Upgrades
1	Hopper and Conveyor Belt	26 000	included		
2	Shredder	20 000		1 000	pre shredder
3	Containers (4)	30 000			
4	Magnets	1 000	240		
5	Scales	8 000			
6	Conveyor for Cardboard	3 000	480		larger electric conveyor belt
7	Transfer Conveyor	2 000	1 000		
8	Conveyor for Nonrecyclables	2 000	1 000		
9	Enlarging Receiving Area	10 590			receiving pit and revolving drum
10	Combining the Two Sorting Tables	37 875	5 000	3 000	
11	Magnetic Conveyor Belt	10 500			
12	Vacuum Separator	17 363			
13	Compactor	12 000			
Total		180 328	7 720	4 000	

* The locations of all the equipment listed here are shown in drawing 2 (Appendix) "Layout after New Installations".

delivered by the bottlers to the shipping and receiving area. From there they are transferred to the glass and plastics handling section of the plant.

5.2.1.2 Sorting. From 1986 until May 1989, the centre had one main sorting system, built by Machinex Inc. of Plessisville, Quebec. A separate table facilitated the sorting of glass (see Appendix A). In May 1989, the two systems were combined (Item 10 in Table 4). Part of the equipment from the old glass-sorting system was re-used to improve the new combined system.

The general layout of the new system is illustrated in Appendix B. Twelve, 14-m^3 containers are arranged in two rows of six. A belt running around the outside of these containers moves the materials along so that the workers can sort them. Another conveyor, located between the two rows of containers, transports the sorted materials to the compactor. Each container has a hydraulic system that can lift and empty the container's contents onto the central conveyor.

A photoelectric cell is used to control the speed at which the materials move.

Primary sorting of cardboard is done right on the floor in the receiving area. The other materials in the receiving bin are taken by an inclined conveyor to the first row of six containers. There a worker spreads out the materials, empties the bags, and places the kraft paper bags in the first container and the cardboard in the second. A conveyor has been installed along the second row of containers, and this conveyor takes scrap materials to a container outside the building.

A second worker places the steel cans in the third container. He also sorts the glass into two wooden bins located behind him: one for white glass, the other for green. Lastly, he takes any plastic containers that are too large for the granulating equipment and places them in another bin.

A third worker completes the sorting on this half of the system by placing the newspapers into the fourth and fifth containers. The sixth container is used to hold mixed paper, as well as plastic waiting to be granulated if the granulating equipment has broken down or the compactor is under repair.

At the end of the first row of containers, a screen is used to remove broken glass, dust, sand, gravel, and small pieces of paper. Next, a magnet (installed at the end of April 1989; Item 4, Table 4) is used to remove any small pieces of steel, which are thrown away.

At the head of the second row of containers is a machine used to shred plastic. This machine was installed in the late summer of 1989 (Item 2 in Table 4). (Plans not included in the current project call for the eventual installation of a pre-shredder. This device would break the containers up into large pieces, thus increasing the efficiency and extending the service life of the existing shredding machine). Once it has been shredded, the plastic is carried by an endless screw to a closed container outside the building (Item 3, Table 4).

The fourth worker, who takes care of the plastic, also removes the aluminum and places it in the seventh container (that is, the first container in the second row). The eighth container is kept available should the granulator go out of service.

A fifth worker sorts the plastic bags and films into the ninth container, removes the non-recyclable materials, and places them on a conveyor (installed in September 1989; Item 8, Table 4). This conveyor takes the non-recyclables to a container outside the building.

The sixth and final worker in the sorting system places the fine paper (black and white, computer paper) into the tenth container. This worker also removes the materials that were missed during sorting and places them on another conveyor installed in

September 1989 (Item 7, Table 4). This conveyor takes these materials back to the receiving bin at the start of the sorting line.

The material remaining on the conveyor belt consists of mixed paper. The mixed paper drops off the end of the line into the eleventh and twelfth containers.

To summarize, the material on the sorting table includes:

- newsprint;
- fine paper (black and white, computer paper);
- mixed paper;
- corrugated cardboard;
- kraft paper bags;
- aluminum;
- metal food cans;
- plastics;
- white glass;
- green glass.

5.2.1.3 Compacting. After being sorted, all materials except glass are compacted and baled in preparation for shipping. There are three different routes to the compactor: the conveyor near the receiving area for cardboard; the conveyor running down the centre of the sorting area for material in the bins; and a magnetic conveyor belt (Item 11, Table 4). The magnetic belt is used mainly to separate ferrous metals from aluminum cans returned by beverage companies.

A scale (Item 5, Table 4) has been installed near the point where the materials emerge from the compactor. The scale is used to weigh the bales, which lets the centre maintain more accurate records of the amount of material recycled.

5.2.1.4 Crushing glass. The centre has facilities for crushing and decontaminating glass. There are two systems for feeding glass into the crusher. In one, a hydraulic lift picks up the bins from the sorting line and empties their contents into a hopper. This hopper feeds them onto a conveyor belt which takes them into the crusher. This glass feeding system (Item 1, Table 4) was installed as part of the current project. The other system used to feed glass into the crusher is an inclined conveyor belt. At the base of the conveyor, the glass deposit containers are sorted by colour, and the empty cardboard boxes are sent by an overhead conveyor (Item 6, Table 4)to the central conveyor in the sorting area. From there they are sent to be compacted and baled. If further modifications are made at a later date, this overhead conveyor could be replaced by a wider one.

When the glass comes out of the crusher, it is passed through a screen which removes polystyrene labelling, aluminum bottlecaps, and large chunks of uncrushed glass. The screened material is sent to the scrap container. The crushed glass is directed into one of three closed containers (Item 3, Table 4). To avoid contamination, glass of each colour is crushed separately.

Two improvements were made in the glass-crushing area as part of this project. Firstly, a vacuum separator (Item 12, Table 4) was mounted above the screen, so that the pieces of polystyrene labelling and the aluminum bottlecaps are removed by vacuum instead of by gravity. The vacuum process improved the quality of glass and prevented scrap materials from clogging the screen. In addition, a dumpster equipped with a compactor (Item 13, Table 4) replaced the scrap container. This greatly reduced the number of trips that have to be made to the landfill site for emptying.

5.2.1.5 Scrap generation. As described in the preceding sections, there are two points where scrap materials are generated: along the

sorting line, and at the outlet of the glass crusher. A significant amount of scrap is also collected off the floor of the centre.

5.2.1.6 Storing and shipping recyclables. The storage area measures 560 m^2. This area is used to store recyclables that have been baled at the centre, as well as unprocessed glass, aluminum, and plastic deposit containers. The bales are stacked three to five high, depending on the type of material in the bale. They are handled with a fork lift. The amount of time each material remains in storage depends on its acceleration rate, the market for the material, and available space in the storage area.

There are four doors where materials can be received from suppliers and distributed to customers.

5.2.2 Staff and schedule

There are usually 14 employees working at the centre, in two separate shifts. Their schedule is:

	Day shift
Monday	8:00 AM to 5:00 PM
Tuesday	7:00 AM to 5:00 PM
Wednesday	7:00 AM to 5:00 PM
Thursday	7:00 AM to 5:00 PM
Friday	8:00 AM to 12:00 PM

	Night shift
Monday	5:00 PM to 1:00 AM
Tuesday	5:00 PM to 1:00 AM
Wednesday	5:00 PM to 1:00 AM
Thursday	5:00 PM to 1:00 AM
Friday	12:00 PM to 6:00 AM

These employees' assignments are:

No of employees	Assignment
Day shift	
6	Sorting table
2	Compactor - 1 operator 1 handler
1	Warehouseman
1	Deposit glass
1	Mechanic
1	Secretary-Bookkeeper
1	Operations manager
Night shift	
2	Compactor - 1 operator - 1 handler
2	Deposit glass

The two employees who operate the compactor on the night shift compact containers (i.e., aluminum and plastic) from the deposit-container operation (and cleaned off the floor), and cardboard. The four night-shift employees also work the sorting line occasionally, for a total of about 12 hours per week.

During peak periods in 1989, a complete sorting team (7 employees) was assigned to the night shift.

Section 6

Amount and Value of Materials Recycled

6.1 Output of the Recycling Centre

To assess the effectiveness of the new layout, the output from the recycling centre had to be determined. The only records available for determining the monthly output are the centre's sales figures and inventory records. The formula used to calculate the centre's monthly output is:

monthly output = sales for month (t) + end-of-month inventory (t) - start-of-month inventory (t)

The figures for the centre's output for the months of May to November in 1988 and in 1989 are shown in Tables 5 to 8.

Since the start of 1989, the waste materials that the centre cannot recycle have been weighed at the landfill. This represents the total amount of waste discharged by the centre.

For the purposes of this report, all figures have been converted into metric tonnes (t or 1 000 kg).

The monthly inventories are taken by counting the number of bales of materials in the centre's storage area. To obtain values in tonnes, the number of bales were multiplied by the average weight per bale, based on previous sales records. This average provided representative results, though the weight of bales can vary depending on how well they are compacted and the condition of the materials.

6.2 Production and Sales of Each Type of Material Under Current Market Conditions

Tables 5 and 6 show the tonnage of materials recovered by the Gaudreau centre from May through November in 1988 and in 1989, and the corresponding values. The values are based on the average sales price for the months in question or on the most recent sales price. Sales figures for the periods in question are shown in Tables 7 and 8, and the prices per tonne for each type of material are shown in Table 9.

The centre's production and sales of each category of materials it handles, as well as market conditions for these materials are analyzed in the following subsections.

6.2.1 Textiles

Textiles are not sorted on the sorting table, because they come from the commercial sector. They represented only 2% of tonnage and sales in 1988, and only 1% in 1989.

6.2.2 Newsprint

Newsprint comes from the residential pickups and is sorted on the sorting table. The tonnage of paper recovered decreased slightly from 1988 to 1989, but the price per tonne dropped more significantly, from $82.50 to $77. The price dropped again in December 1989, to $45 per tonne, and once more in February 1990, to $25. By volume, newsprint, along with mixed paper, accounts for the greatest proportion of the materials sorted by the centre, and it represents about 17% of the centre's output.

The increase in the amount of newsprint recovered throughout North America has resulted in a surplus of recovered newsprint. The increased supply has caused the export market to shrink; prices are currently running at $9 to $15 per tonne and are likely to drop

Table 5 Materials Recovered in 1988

Material	May		June		July		August		September	
	t	$	t	$	t	$	t	$	t	$
Textiles			32.70	2 521.40	5.00	385.00	9.53	735.00	6.70	535.00
Newsprint	56.39	4 624.11	103.34	8 525.34	39.28	3 240.33	100.92	8 325.90	69.23	4 733.95
Black and White Paper	42.78	10 610.57	7.49	1 856.62	4.48	1 109.90	4.00	992.00	5.00	1 240.00
White Paper			1.00	209.00	1.75	366.32				
Coloured Paper	15.91	2 273.70					1.00	143.00		
Mixed Paper	118.47	4 286.32	160.51	6 259.88	82.75	3 227.14	104.21	3 037.81	105.38	3 727.30
Corrugated Cardboard	168.65	1 695.35	155.15	15 359.43	140.97	13 956.03	180.58	17 877.73	165.54	16 388.56
Kraft Paper					2.50	275.00	2.00	220.00		
Aluminum			1.77	3 042.19	3.75	6 446.15	0.82	1 334.85	1.09	1 779.80
Metal Food Cans	2.72	180.00	2.35	155.40	1.63	108.00	3.27	216.00	2.90	192.00
PET Plastic			6.53	1 959.00	3.54	1 061.71	3.00	900.00	4.82	1 446.53
Granulated Plastic										
Post-consumer Plastic										
White Glass	20.42	1 462.68	49.27	3 529.21	82.28	5 915.00	62.34	4 465.50	42.38	3 077.88
Green Glass			12.61	903.50	13.61	975.00	24.50	1 755.00	4.54	325.00
Total	425.34	25 132.73	532.72	44 320.97	381.54	37 065.58	496.17	40 002.79	407.58	33 445.92

Note: These figures have been calculated on Lotus. Since many decimal places were used and figures were not rounded, the totals will not be exact.

Table 6 Materials Recovered in 1989

Material	May		June		July		August		September	
	t	$	t	$	t	$	t	$	t	$
Textiles	8.99	694.08	8.48	654.00	5.72	441.24	1.63	125.74	4.61	355.62
Newsprint	102.93	6 690.45	84.01	5 460.65	40.79	2 651.56	65.67	4 269.04	70.70	4 595.60
Black and White Paper	7.71	1 912.08	2.74	680.51	7.15	1 773.69			6.05	1 500.40
White Paper	2.74	602.80								
Coloured Paper										
Mixed Paper	78.07	2 185.96	92.75	2 596.93	13.17	386.76	66.00	1 848.00	65.89	1 844.86
Corrugated Cardboard	189.45	15 964.95	136.61	10 708.86	111.89	8 392.05	184.59	13 844.58	131.51	9 863.25
Kraft Paper	4.50	900.00	3.22	644.00	3.31	662.00	7.00	1 400.00	4.36	872.00
Aluminum	1.94	3 521.10	1.56	2 825.96	5.83	8 162.00	4.75	6 644.82	4.28	5 992.00
Metal Food Cans	5.72	343.20	0.82	49.20	3.67	220.20	4.55	273.00	4.49	269.40
PET Plastic	4.02	1 125.60	10.82	3 029.60	13.61	3 811.58	8.94	2 503.58	14.02	3 924.40
Granulated Plastic										
Post-consumer Plastic										
White Glass	25.95	1 859.00	112.89	8 086.00	113.79	8 151.00	130.22	9 327.50	92.56	6 630.00
Green Glass	18.51	1 326.00	13.61	1 565.00	9.80	702.00	65.43	4 680.00	22.69	1 625.00
Total	450.53	37 125.22	467.51	36 300.71	328.73	35 354.08	538.78	44 916.26	421.16	37 472.53

Note: These figures have been calculated on Lotus. Since many decimal places were used and figures were not rounded, the totals will not be exact.

October		November		Total				Average (7 months)		Extrapolated over 12 months	
t	$	t	$	t	%	$	%	t	$	t	$
5.31	409.50	12.82	989.10	72.06	2.2	5 575.00	2.1	10.29	796.43	123.53	9 557.14
105.70	8 720.07	109.29	9 016.46	584.15	18.2	47 186.16	17.8	83.45	6 740.88	1 001.40	80 890.56
10.91	2 706.35	3.00	744.00	77.66	2.4	19 259.44	7.2	11.09	2 751.35	133.13	33 016.18
4.97	1 039.36	4.40	1 047.20	12.12	0.4	2 661.88	1.0	1.73	380.27	20.78	4 563.22
		1.50	214.50	18.41	0.6	2 631.20	1.0	2.63	375.89	31.56	4 510.63
109.98	2 878.18	94.01	3 666.23	775.31	24.1	27 082.76	10.2	110.76	3 868.97	1 329.10	46 427.59
159.58	15 797.97	205.52	20 346.93	1 175.99	36.6	101 422.00	38.2	168.00	14 488.86	2 015.98	173 866.29
4.50	495.00			9.00	0.3	990.00	0.4	1.29	141.43	15.43	1 697.14
0.54	889.90	3.09	5 052.84	11.06	0.3	18 545.73	7.0	1.58	2 649.39	18.96	31 792.68
2.46	162.60	6.30	416.40	21.63	0.7	1 430.40	0.5	3.09	204.34	37.08	2 452.11
1.63	490.02	5.99	1 796.73	25.51	0.8	7 653.99	2.9	3.64	1 093.43	43.73	13 121.13
86.75	6 300.75	6.17	442.00	349.61	10.9	25 193.02	9.5	49.94	3 599.00	599.33	43 188.03
10.62	760.50	18.15	1 300.08	84.03	2.6	6 019.08	2.3	12.00	859.87	144.05	10 318.42
502.95	40 650.20	470.24	45 032.47	3 216.54	100	265 650.66	100	459.51	37 950.09	5 514.07	455 401.13

October		November		Total				Average (7 months)		Extrapolated over 12 months	
t	$	t	$	t	%	$	%	t	$	t	$
3.27	252.00	5.72	441.00	38.42	1.2	2 963.68	1.08	5.49	423.38	65.86	5 080.59
73.51	4 778.15	82.51	5 363.15	520.12	16.4	33 808.60	12.4	74.30	4 829.80	891.63	57 957.60
2.75	682.00	4.95	1 227.60	31.35	1.0	7 776.28	2.85	4.48	1 110.90	53.74	13 330.77
8.25	1 815.00	20.35	4 477.00	31.34	1.0	6 894.80	2.53	4.48	984.97	53.73	11 819.66
3.00	396.00	2.20	290.40	5.20	0.2	686.40	0.25	0.74	98.06	8.91	1 176.69
95.56	2 675.68	100.56	2 815.68	512.00	16.1	14 353.87	5.27	73.14	2 050.55	877.71	24 606.63
149.46	12 690.65	181.39	17 232.05	1 084.90	34.2	88 696.39	32.5	154.99	12 670.91	1 859.83	152 050.95
3.65	730.00	4.08	816.00	30.12	0.9	6 024.00	2.21	4.30	860.57	51.63	10 326.86
1.40	1 966.13	2.33	3 272.55	22.09	0.7	32 384.56	11.9	3.16	4 626.37	37.87	55 516.39
4.90	294.00	9.02	541.20	33.17	1.0	1 990.20	0.73	4.74	284.31	56.86	3 411.77
2.47	691.60	13.26	3 712.80	67.14	2.1	18 799.16	6.90	9.59	2 685.59	115.10	32 227.13
70.05	5 018.00	87.39	6 259.50	632.85	19.9	45 331.00	16.6	90.41	6 475.86	1 084.89	77 710.29
12.79	915.50	22.14	1 586.00	164.97	5.2	12 399.50	4.55	23.57	1 771.36	282.81	21 256.29
431.06	32 904.71	535.90	48 034.93	3 173.67	100	272 108.44	100	453.38	38 872.63	5 440.58	466 471.61

Table 7 Sales of Recovered Materials in 1988

Material	May		June		July		August		September	
	t	$	t	$	t	$	t	$	t	$
Textiles			30.90	2 381.40			21.32	1 645.00		
Newsprint	62.29	5 115.99	121.84	10 051.31	26.50	2 186.00	96.01	7 920.00	49.08	3 355.85
Black and White Paper	34.30	8 505.41			18.45	4 575.10				
White Paper	6.95	1 451.50			3.25	678.62				
Coloured Paper	11.91	1 702.85			1.50	214.07				
Mixed Paper	166.63	6 029.26	80.90	3 155.18	28.42	1 108.50	199.05	5 801.42	121.11	4 284.00
Corrugated Cardboard	189.97	18 805.45	118.83	11 763.18	150.67	14 916.43	200.32	19 830.68	167.12	16 545.88
Kraft Paper										
Aluminum					5.52	9 487.52				
Metal Food Cans			7.03	464.40					4.54	300.00
PET Plastic									16.80	5 040.00
Granulated Plastic										
Post-consumer Plastic							11.60	6 960.00		
White Glass	20.41	1 462.50	51.09	3 659.50	49.00	3 510.00	48.73	3 490.50	51.45	3 685.50
Green Glass			21.23	1 553.50			24.50	1 755.00		
Total	492.46	43 072.96	431.82	33 028.47	283.31	36 676.24	601.53	47 402.60	410.10	33 211.23

Note: These figures have been calculated on Lotus. Since many decimal places were used and figures were not rounded, the totals will not be exact.

Table 8 Sales of Recovered Materials in 1989

Material	May		June		July		August		September	
	t	$	t	$	t	$	t	$	t	$
Textiles			17.47	1 345.50					16.04	1 237.67
Newsprint	85.54	5 560.28	120.88	7 857.41	56.57	3 676.86	62.10	4 036.38	72.74	4 727.65
Black and White Paper	22.00	5 456.00					7.23	1 792.78		
White Paper	5.50	1 210.00								
Coloured Paper										
Mixed Paper	86.71	2 427.91	95.91	2 685.29	46.96	1 398.88	77.59	2 172.52	62.20	1 741.60
Corrugated Cardboard	185.91	15 666.09	158.28	12 408.08	107.47	8 060.55	181.94	13 645.50	127.56	9 567.00
Kraft Paper							18.98	3 795.20		
Aluminum			6.80	12 349.26			7.86	11 008.20		
Metal Food Cans							10.26	615.60		
PET Plastic					16.70	4 676.00	15.74	4 407.20	16.49	4 617.20
Granulated Plastic										
Post-consumer Plastic										
White Glass	30.49	2 184.00	85.66	6 136.00	109.26	7 826.00	134.75	9 652.50	110.71	7 930.00
Green Glass	27.59	1 976.00			27.95	2 002.00	29.13	2 085.50		
Total	443.74	34 480.28	485.00	42 781.54	364.91	27 640.29	545.58	52 211.38	405.74	29 821.12

Note: These figures have been calculated on Lotus. Since many decimal places were used and figures were not rounded, the totals will not be exact.

October		November		Total				Average (7 months)		Extrapolated over 12 months	
t	$	t	$	t	%	$	%	t	$	t	$
		18.13	1 398.25	70.35	2.3	5 424.65	2.0	10.05	774.95	120.60	9 299.40
73.79	6 087.18	92.53	7 634.47	522.04	16.8	42 350.80	15.3	74.58	6 050.11	894.93	72 601.37
17.90	4 438.95	3.00	744.00	73.65	2.4	18 263.46	6.6	10.52	2 609.07	126.26	31 308.79
4.97	1 039.36			15.17	0.5	3 169.48	1.1	2.17	452.78	26.01	5 433.59
1.49	213.21			14.90	0.5	2 130.13	0.8	2.13	304.30	25.54	3 651.65
71.66	1 875.08	78.77	3 071.99	746.54	24.0	25 325.43	9.1	106.65	3 617.92	1 279.78	43 415.02
167.08	16 541.62	183.02	18 119.48	1 177.01	37.8	116 522.72	42.0	168.14	16 646.10	2 017.73	199 753.23
		14.71	1 621.37	14.71	0.5	1 621.37	0.6	2.10	231.62	25.22	2 779.49
		5.95	9 724.98	11.47	0.4	19 212.50	6.9	1.64	2 744.64	19.66	32 935.71
7.36	486.60	6.71	443.40	25.64	0.8	1 694.40	0.6	3.66	242.06	43.95	2 904.69
				16.80	0.5	5 040.00	1.8	2.40	720.00	28.80	8 640.00
				11.60	0.4	6 960.00	2.5	1.66	994.29	19.89	11 931.43
91.29	6 539.00	28.86	2 067.00	340.83	10.9	24 414.00	8.8	48.69	3 487.71	584.28	41 852.57
28.77	2 060.50			74.50	2.4	5 369.00	1.9	10.64	767.00	127.71	9 204.00
464.31	39 281.50	431.68	44 824.94	3 115.21	100	277 497.94	100	445.03	39 642.56	5 340.36	475 710.75

October		November		Total				Average (7 months)		Extrapolated over 12 months	
t	$	t	$	t	%	$	%	t	$	t	$
				33.51	1.1	2 583.17	1.0	4.79	369.02	57.45	4 428.29
50.01	3 250.33	103.97	6 757.28	551.81	17.4	35 866.19	13.4	78.83	5 123.74	945.96	61 484.90
				29.23	0.9	7 248.78	2.7	4.18	1 035.54	50.11	12 426.48
				5.50	0.2	1 210.00	0.5	0.79	172.86	9.43	2 074.29
75.03	2 100.84	100.56	2 815.68	544.96	17.2	15 342.72	5.8	77.85	2 191.82	934.22	26 301.81
155.21	13 179.10	162.38	15 426.02	1 078.75	34.0	87 952.34	33.0	154.11	12 564.62	1 849.29	150 775.44
				18.98	0.6	3 795.20	1.4	2.71	542.17	32.54	6 506.06
8.59	12 063.33			23.25	0.7	35 420.79	13.3	3.32	5 060.11	39.86	60 721.35
		19.23	1 153.80	29.49	0.9	1 769.40	0.7	4.21	252.77	50.55	3 033.26
		18.20	5 096.00	67.13	2.1	18 796.40	7.0	9.59	2 685.20	115.08	32 222.40
47.37	3 393.00	199.45	8 534.50	637.69	20.1	45 656.00	17.1	91.10	6 522.29	1 093.18	78 267.43
26.41	1 891.50	44.92	3 211.00	156.00	4.9	11 166.00	4.2	22.29	1 595.14	267.43	19 141.71
362.62	35 878.10	568.71	42 994.28	3 176.30	100	266 806.99	100	453.76	38 115.28	5 445.09	457 383.41

Table 9 Sales Prices of Materials Recovered in 1988 and 1989

Material	Sales Price ($/t) 1988	1989
Textiles	77	77
Newsprint	82.50	65
Black and White Paper	248	248
White Paper	209	270
Coloured Paper	143	---
Mixed paper	20 and 39*	28
Corrugated Cardboard	99	95 and 75*
Kraft Paper	110	200
Aluminum	1 718 (July); 1 634 (Nov.)	1 815 (June); 1 400 (Aug., Oct.)
Metal Food Cans	66	66
PET Plastic	300	280
White Glass	71.50	71.50
Green Glass	71.50	71.50

* Variation in sales price during the year

further. This situation will continue until deinking facilities are set up in Canada. Many U.S. states now require newspapers to use newsprint containing recycled fibres, which should encourage the construction of such units and revive the market for recycled newsprint.

6.2.3 Black and White Paper, White Paper, and Coloured Paper

Part of the paper that Gaudreau handles in these categories comes from residential collection and is sorted as fine paper on the sorting table. The rest comes from the commercial sector. All together, fine paper accounted for 3.4% of the centre's tonnage and 8.5% of its revenues in 1988, and for 2.2% of its tonnage and 5.6% of its revenues in 1989. The more selective sorting method used in 1988 was discontinued in 1989 to reduce sorting time.

6.2.4 Mixed Paper

Mixed paper consists of the paper left over at the end of the sorting line. The installation of the screen, magnetic roller, and transfer conveyor has enabled the centre to remove many contaminants and produce a better quality of mixed paper. In 1988, mixed paper was the single largest product of the sorting operation, accounting for 24.1% of total tonnage. In 1989, however, it ran even with newsprint, at 16.1%. The price of mixed paper also decreased from 1988 to 1989, from an average of $35 per tonne to $28 per tonne. It should be noted that approximately one-quarter of the mixed paper consists of magazines. Sales of mixed paper vary with the markets for construction materials, and insulating paper for cars, household and other appliances.

6.2.5 Corrugated Cardboard

The corrugated cardboard processed by the centre comes almost exclusively from pick-ups at businesses; only 10% comes from the sorting line. corrugated cardboard is the single most important material processed by the centre. The tonnages processed in 1988 and 1989 were similar, representing 35% of the total output. But in this category too, revenues shrank. From 1988 to 1989, the

average price per tonne fell from $99 to $82, causing revenues to drop from 38.2% of the total to 32.5% of the total. Following the period covered by this study, prices fell even more, to $60 per tonne in December 1989 and $55 per tonne in February 1990.

The reason for these price decreases is that some U.S. states have now passed regulations prohibiting the disposal of cardboard in landfills, and the costs of disposal have increased. Hence the amount of recovered corrugated cardboard on the market has increased considerably, with prices falling accordingly. There are no indications that prices will move upward in the short term. This presents a major problem for the centre, because cardboard is its main source of revenue.

6.2.6 Kraft Paper

Kraft paper comes from the residential collections and is sorted on the sorting table. Most of the kraft paper consists of paper bags. The tonnage of this material increased considerably from 1988 to 1989. Comparing the same 7-month period in both years, we see the figure rose from 9.0 to 30.1 t, an increase of 3.3. At the same time, the price rose from $110 per tonne to $200 per tonne. As a result, the percentage of sales accounted for by this category also rose noticeably, from 0.4% in 1988 to 2.2% in 1989.

6.2.7 Aluminum

The aluminum handled by the centre consists of deposit cans collected by bottlers, who bring them to the centre for processing. A small amount of aluminum is also recovered in the sorting operation. The magnetic conveyor belt that has been installed at the intake to the compactor should eliminate the steel cans and pieces of metal contaminating the aluminum and provide a better quality of finished product.

The amount of aluminum recovered doubled in 1989 over 1988, increasing from 0.3% to 0.7% of the total tonnage. However, the increase in sales revenues was slightly lower, because of the fluctuation in the price of aluminum. The average price per tonne of aluminum fell from $1675 in 1988 to $1466 in 1989. Though the tonnage of aluminum that the centre processes is rather small, this metal accounted for 11.9% of its sales revenues in 1989. The increased use of aluminum containers by bottlers should benefit the centre in future.

Because the volumes of aluminum processed were so small sales were made every four months in 1988 and every two months in 1989.

6.2.8 Metal Food Cans

The food cans processed by the centre come solely from residential collection. The volume sorted increased slightly from 1988 to 1989, accounting for 1% of the total.

Because the volume of cans processed is so small, the centre does not sell them every month.

6.2.9 PET Plastic

The centre's supply of PET plastic consists of deposit soft-drink containers. The centre simply bales and sells PET. In proportion to aluminum and glass (two other materials obtained largely from deposit operations), the centre's output of PET plastic increased significantly from 1988 to 1989, rising from 0.8% to 2.1% of the total tonnage. The price for this material was also strong in 1989: $280 per tonne. Twinpack Inc, the only company in Canada that buys recovered PET, has announced a price decrease that will take effect on 1 January 1990. The centre expects to receive $200 per tonne for its next shipments of this material. The reasons for this price decrease are twofold: competition from other companies that manufacture PET containers with no recycled component, and a drop in the price of virgin resin.

6.2.10 Granulated Plastic and Post-consumer Plastic. The plastic-granulating machine was not installed until the end of the summer. There was only one sale of these materials (August 1989) so no comparisons can be made. The market for virgin resins is in decline and the price for recycled resin will probably fall. However, the plastic can be stored outside Gaudreau should be able to store the material and sell in large volumes when prices are conducive.

6.2.11 White and Green Glass. The main source of these glasses is deposit containers. In 1989, efforts were made to increase the volume of deposit containers processed by the centre. These efforts were successful: the amount processed nearly doubled. Taken together, these materials increased from 13.5% of the total weight in 1988 to 25.1% in 1989, and from 11.8% of sales revenues in 1988 to 21.2% in 1989. However, these materials came not only from collections in the Bois-Francs area, but from a much wider area. This source of supply is not secure.

The market for recovered glass is stable, but purchasers demand excellent quality. There is no more market for the brown and coloured glass collected from residences. At present only white glass and green glass get recycled. The glass crushing and decontamination equipment that has been installed at the centre gives it an advantage in the marketplace, because of the quality of product it can provide.

6.3 Amount of Materials Recycled and Discarded by the Centre in 1989

Section 5.2.1.5 mentions the locations in the centre where scrap materials are generated. Data for 1989 can be used to determine the total amount of material processed and the percentage discarded.

Table 10 shows that in 1989, an average of 502 tonnes of materials were received at the centre each month, and that 9.7% of this material was disposed of at the landfill. If it is assumed that a similar percentage of material was discarded in 1988, the amounts of material processed in 1988 and 1989 were comparable.

Extrapolating for 1989, the amount of material received at the centre over 12 months was approximately 6 000 t, of which 5 500 t were recovered.

6.4 Processing Capacity of the Centre

According to the figures obtained previously, the centre is currently processing 22 tonnes of material per day, or 5 500 t over the 250 working days in a year. The centre's actual capacity is hard to estimate, but the centre is not operating at full capacity now. Theoretically, its peak capacity with the available equipment and staff would be 30 to 35 t/d.

Table 10 Amount of Materials Recycled and Discarded in 1989

Month	Amount Recycled (t)	Amount Discarded (t)	Total (t)	Percentage Discarded (%)
May	450.53	41.93	492.46	8.5
June	467.51	46.06	513.57	9.0
July	328.78	44.29	373.02	11.9
August	538.78	41.32	580.10	7.1
September	421.16	49.82	470.98	10.6
October	431.06	74.25*	505.31	14.7
November	535.90	41.89	577.79	7.3
Total	3 173.67	339.56	3 513.23	9.7
Monthly Av.	453.38	48.51	501.89	9.7
Extrapolation over 12 months	5 440.58	582.10	6 022.68	9.7

* includes about 34 tonnes of scrap deposit glass

Section 7

Economic Analysis

The financial data in Table 11 are taken from the most recent financial statements issued by the centre. Since November 1988, the collection and sorting of recyclables have been carried out by two separate companies. But for purposes of comparing 1988 and 1989, the two companies' figures for November 1988 and for 1989 have been combined in this table. Only the months covered by this study (May through November) are presented, and the average for the 7 months will be used for analyzing and comparing the values.

The cost figures have been broken down in detail so as to clearly identify the areas where the changes have been greatest and determine the operation's potential profitability. Table 12 summarizes the data in Table 11 and shows the costs in dollars per metric tonne, per pick-up point, per month, and per year.

Since 1984, the municipalities have been paying a flat amount per pick-up point for the collection of recyclable materials. This amount has averaged $9.50 per year. In theory, this amount is supposed to cover the costs of collecting the materials, but in practice, it does not. In 1988, when RBF was collecting the recyclables (except in November), collection costs averaged $25 908 per month, which represented a deficit of $7 517 per month. In 1989, after Récupération Gaudreau Inc. took over the collection operation, they managed to reduce costs by 178%, to $21 307 per month. Revenues remained comparable to those in 1988, and the deficit was reduced to $2 775 per month. The deficit for collection operations was reduced from $3.86 per pick-up point per year in 1988 to $1.43 per pick-up point per year in 1989.

The average monthly cost of processing materials in the centre rose from $30 986 in 1988 to $37 550 in 1989, an increase of 21%. Two main factors were responsible for this increase. First, payroll costs rose by 38% because the change in collection methods created more work for the centre and because a night shift of 7 workers was put onto the sorting equipment in October and November to handle materials received from Quebec City. Second, maintenance costs increased by 143% ($3 515 per month) because of expenses related to the installation of new equipment. If we exclude this latter increase, the increase in costs of processing recyclables goes down to about 10%.

Adding the costs of collecting the recyclables, the costs of processing them, and certain other, sales-related expenses, we get the cost of sales. This figure increased only 2.6% from 1988 to 1989 (from $58 432 per month to $59 940 per month). If we again exclude the expenses related to the equipment changes (approximately $3 515 per month), the cost of sales decreased by 3.4%.

In other words, the net result of the changes in collection and sorting methods was that the reduction in collection costs offset the increase in processing costs.

Adding together the cost of sales, administrative expenses, and financing costs, we get the total expenditures. For the 7 months covered by this study, this total increased 4.2% on average from 1988 to 1989 (or decreased 1.1%, if the costs related to the equipment changes are excluded). This 4.2% increase is greater than the 2.6% increase in the cost of sales. The reason for it is that when the recycling centre was purchased, high financing charges were paid in

Table 11 Financial Analysis for 1988 and 1989

	May		June		July		August		September	
	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989
Cost of Sales										
Cost of Collecting Recyclables										
. wages	12 345.00	7 840.00	14 746.18	8 560.00	11 581.00	10 419.30	11 239.26	10 048.75	1 847.20	11 161.73
. benefits	860.51	1 469.76	4 933.30	1 489.75	3 128.98	1 507.20	2 935.16	936.36	2 890.62	1 546.69
. gasoline	3 126.30	2 500.00	4 085.06	2 500.00	3 876.10	2 500.00	3 572.32	3 500.00	3 480.58	2 064.43
. maintenance	2 576.03	2 729.87	2 384.65	2 501.87	4 379.79	9 697.10	3 361.65	2 667.11	1 318.28	2 463.91
. insurance	390.48	500.00	488.10	500.00	488.10	345.00	390.48	345.00	507.56	345.00
. other costs[1]	3 925.68	3 568.00	4 054.71	3 673.38	4 099.37	3 530.38	2 961.13	3 915.38	12 591.76	3 465.38
Total Cost of Collecting Recyclables	23 224.00	18 608.00	30 692.00	19 225.00	27 554.00	27 999.00	24 460.00	21 413.00	22 636.00	21 047.00
Cost of Processing Recyclables										
. sorting . wages	6 607.23	12 011.42	9 830.79	7 420.80	6 508.49	10 013.51	8 195.30	10 054.03	7 978.72	8 895.19
. benefits	2 818.58	3 362.94	3 288.87	1 860.92	1 663.53	2 234.52	2 117.90	2 406.58	2 132.97	2 090.02
. compactor . wages	4 184.58	3 052.49	4 377.11	2 524.22	3 971.01	4 097.97	3 980.58	3 560.09	4 352.03	4 831.32
. benefits	1 785.10	867.17	1 450.97	625.17	998.12	914.46	1 028.70	852.16	1 163.44	1 135.32
. other[2] . wages		324.00				282.00				315.00
. benefits										
. electricity	1 153.92	1 443.51	1 442.30	1 153.84	1 442.30	1 442.30	1 153.84	1 153.84	1 178.58	1 154.75
. taxes and licences	445.80	766.60	557.25	613.28	557.25	76.60	445.80	613.28	445.80	613.28
. insurance	1 592.00	1 722.75	1 990.00	1 378.20	1 990.00	1 838.15	1 592.00	1 470.52	1 752.80	1 470.52
. equipment maintenance	2 529.80	1 412.97	1 743.00	5 231.54	1 575.62	4 080.86	1 862.98	3 738.79	1 841.49	1 551.79
. building maintenance	245.34	273.65	764.56	1 618.51	460.03	705.19	219.91	13 758.95	229.71	346.30
. other costs	7 198.65	10 853.50	11 109.15	10 923.52	9 596.65	12 513.44	9 705.99	(4 799.24)	10 890.46	11 960.51
Total Cost of Processing Recyclabes	28 561.00	36 091.00	36 554.00	33 350.00	28 763.00	38 199.00	30 303.00	32 809.00	31 966.00	34 364.00
Transportation Costs	419.00	1 401.00	1 233.00	1 272.00	804.00	3 600.00	2 025.00	1 350.00	800.00	1 800.00
Other Costs	8 484.00	(765.00)	(10 638.00)	1 839.00	185.00	(4 177.00)	3 733.00	7 974.00	654.00	(5 399.00)
Cost of Sales	60 688.00	55 335.00	57 841.00	55 686.00	57 306.00	65 621.00	60 521.00	63 546.00	56 056.00	51 812.00
Sales Expenses	35.00		(35.00)							
Administrative Expenses	6 089.00	6 987.00	9 092.00	5 784.00	8 226.00	7 019.00	5 574.00	5 129.00	7 168.00	5 974.00
Financing Costs	330.00	722.00	870.00	463.00	761.00	363.00	756.00	425.00	714.00	7 978.00
Total Expenditures	67 142.00	63 044.00	67 768.00	61 933.00	66 293.00	73 003.00	66 851.00	69 100.00	63 938.00	65 764.00
Income from Sales of Materials	43 925.00	37 274.00	35 694.00	39 236.00	49 138.00	40 044.00	42 728.00	42 936.00	32 993.00	28 841.00
Income from Municipal Contracts	16 774.00	15 549.00	18 697.00	17 962.00	18 916.00	22 146.00	16 996.00	16 074.00	16 996.00	20 120.00
Other Income	3 582.00	(622.00)	6 885.00	5 844.00	899.00	(807.00)	815.00	(52.00)	1 858.00	1 351.00
Total Income	64 281.00	52 201.00	61 276.00	63 042.00	68 953.00	61 383.00	60 539.00	58 958.22	51 847.00	51 312.00
Net Profit	(2 861.00)	(10 843.00)	(6 492.00)	1 109.00	2 660.00	(11 620.00)	(6 312.00)	(10 141.78)	(12 091.00)	(14 452.00)

Notes:
1. Includes leasing a truck in 1988, depreciation and interest
2. Includes contract employees
3. Includes mainly depreciation, interest, and packaging
4. Includes surplus inventory and purchases of raw materials
5. Based on 1988 financial statement
6. Projection (monthly average for 7 months) x 12

October		November		Total		Average (7 months)		Extrapolated over 12 months	
1988	1989	1988	1989	1988	1989	1988	1989	1988[5]	1989[6]
10 507.99	9 237.56	9 070.94	7 661.63	71 338.23	64 928.97	10 191.18	9 275.57	96 148.92	111 306.81
3 832.85	1 249.28	827.02	1 108.78	19 408.44	9 307.82	2 772.63	1 329.69	27 747.87	15 956.26
3 104.59	2 425.16	2 812.54	1 891.49	24 057.49	17 381.08	3 436.78	2 483.01	29 491.60	29 796.14
2 227.83	4 803.80	6 280.39	4 351.96	22 528.62	29 215.62	3 218.37	4 173.66	25 485.32	50 083.92
507.56	345.00	634.45	345.00	3 406.73	2 725.00	486.68	389.29	6 139.85	4 671.43
3 459.18	3 465.38	9 522.90	3 975.38	40 614.73	25 593.28	5 802.10	3 656.18	44 008.44	43 874.19
23 640.00	21 526.00	29 148.00	19 334.00	181 354.00	149 152.00	25 907.71	21 307.43	229 022.00	255 689.14
5 205.42	11 439.24	9 235.27	17 637.63	53 561.22	77 471.82	7 651.60	11 067.40	95 438.04	132 808.83
1 549.93	2 702.95	2 019.30	4 163.41	15 591.08	18 821.34	2 227.30	2 688.76	23 424.92	32 265.15
4 771.64	3 843.64	3 957.98	3 359.55	29 594.93	25 269.28	4 227.85	3 609.90	47 582.49	43 318.77
1 420.77	908.20	865.43	93.03	8 712.53	5 395.51	1 244.65	770.79	12 191.89	9 249.45
	650.00		570.00		2 141.00		305.86		3 670.29
					0.00		0.00		0.00
1 129.10	1 127.06	1 442.60	1 442.30	8 942.64	8 917.60	1 277.52	1 273.94	15 050.84	15 287.31
445.80	613.28	557.25	766.10	3 454.95	4 062.42	493.56	580.35	6 807.58	6 964.15
1 752.80	1 513.84	2 191.00	1 892.30	12 860.60	11 286.28	1 827.23	1 612.33	23 798.56	19 347.91
3 201.04	2 055.98	1 698.91	3 374.32	14 452.84	21 446.25	2 064.69	3 063.75	24 575.73	36 765.00
46.52	2 353.52	777.56	1 297.95	2 743.63	20 354.07	391.95	2 907.72	5 126.24	34 892.69
7 353.987	12 453.29	11 129.70	13 780.41	66 984.58	67 685.43	9 569.23	9 669.35	111 914.71	116 032.17
26 877.00	39 661.00	33 875.00	48 377.00	216 899.00	262 851.00	30 985.57	37 550.14	365 911.00	450 601.71
1 200.00	2 198.00	800.00	2 498.00	7 281.00	14 119.00	1 040.14	2 017.00	12 752.00	24 204.00
3 626.00	(1 416.00)	(2 557.00)	(4 596.00)	3 487.00	(6 540.00)	498.14	(934.29)	(1 933.00)	(11 211.43)
55 343.00	61 969.00	61 266.00	65 613.00	409 021.00	419 582.00	58 431.57	59 940.29	605 752.00	719 283.43
				0.00	0.00	0.00	0.00	300.00	0.00
6 620.00	7 259.00	6 703.00	11 860.00	49 472.00	50 012.00	7 067.43	7 144.57	82 353.00	85 734.86
45.00	2 645.00	1 026.00	102.00	4 502.00	12 698.00	643.14	1 814.00	6 854.00	21 768.00
62 008.00	71 873.00	68 995.00	77 575.00	462 995.00	482 292.00	66 142.14	68 989.86	695 260.00	826 786.29
35 465.00	35 913.00	51 618.00	53 522.00	291 561.00	278 766.00	41 651.57	39 823.71	449 212.00	477 884.57
19 218.00	18 118.00	21 140.00	19 765.00	128 737.00	129 734.22	18 391.00	18 533.46	147 344.00	222 401.52
1 926.00	1 731.00	3 978.00	1 566.00	19 943.00	9 011.00	2 849.00	1 287.29	19 313.00	15 447.43
56 609.00	55 762.00	76 736.00	74 853.00	440 241.00	417 511.22	62 891.57	59 644.46	615 869.00	715 733.52
(5 399.00)	(16 111.00)	7 741.00	(2 722.00)	(22 754.00)	(64 780.78)	(3 250.57)	(9 254.40)	(79 391.00)	(111 052.77)

Table 12 Financial Analysis for 1988 and 1989

Item[1]	$/month[2] 1988	1989	$/t[3] 1988	1989	$/pick-up point per month[4] 1988	1989	$/pick-up point per year[4] 1988	1989
Collection Operations								
Income	18 391	18 533	40.13	40.44	0.79	0.79	9.45	9.52
Expenses	25 908	21 307	56.53	46.49	1.11	0.91	13.31	10.95
Profit (loss)	(7 517)	(2 774)	(16.40)	(6.05)	(0.32)	(0.12)	(3.86)	(1.43)
Processing Costs	30 986	37 550	67.61	81.93	0.15	1.61	15.92	19.30
Cost of Sales	58 432	59 940	127.49	130.78	2.50	2.57	30.03	30.80
Total Expenditures	66 142	68 899	144.31	150.33	2.83	2.95	33.99	35.41
Income from Sales	41 652	39 824	90.88	86.89	1.78	1.71	21.41	20.47
Total Income	62 892	59 644	137.22	130.13	2.69	2.55	32.32	30.65
Profit (loss)	(3 251)	(9 254)	(7.09)	(20.19)	(0.14)	(0.40)	(1.67)	(4.76)

Notes:
1 see Table 11
2 Based on a 7-month average
3 Based on 5 500 t/yr or 458 t/mon
4 Based on 23 350 pick-up points

September and October 1989, so that the average financing costs in 1989 were three times higher than in 1988. Total expenditures rose from $66 142 per month in 1988 to $68 899 per month in 1989.

As seen in Section 6, revenues from the sale of recycled materials were generally down in 1989, so that total income was 5.2% lower than in the preceding year ($59 644 per month, as opposed to $62 892).

When we subtract expenditures from income, the bottom line for the collection and processing operations combined shows an increase in the deficit, from $3 251 per month

in 1988 to $9 254 per month in 1989. On an annual basis, this represents a 1989 deficit of $1.43 per pick-up point per year for the collection operations and $3.33 per pick-up point per year for the processing operations, for a total of $4.76 per pick-up point per year, compared with $3.40* per pick-up point per year in 1988.

In terms of profitability, the current factors do not point to a profitable business. However, this lack of profitability is mainly due to the imbalance between operating costs and income. A brief financial analysis shows that the business's working capital and ability to repay are inadequate. Moreover, the initial capital cost is substantial, approximately $1.3 million, which represents an amortization of about $80 000/yr. To be profitable, this business will have to rationalize its costs of production and increase its revenues. To increase its revenues, the company will have to obtain better financial compensation from the municipalities, because the market is currently down. In this connection, the municipalities should regard recycling as an economic priority, because the cost of placing materials in landfills is likely to increase.

The municipalities have not had to absorb an increase in the price of MSW-collection services for three or four years, partly because so much material in this region is recycled. But the new rates will reflect the increase in the price of landfilling to a minimum of $18 per tonne. Thus the 5 500 tonnes of materials diverted from landfills and recycled each year theoretically represent an annual savings of $99 000, or $4.25 per pick-up point. If this amount were transferred to the recycling centre, its deficit would be reduced to $0.51 per pick-up point per year.

7.1 Recommendations for Improving RBF's Profitability

In October 1988, a report on the profitability of the recycling centre included several recommendations. The main recommendations are listed below, along with comments on the extent to which they have been implemented.

1. **Equalize costs of collection and revenue from municipalities.** Several collection contracts were renegotiated with municipalities at the end of January 1990. The goal of the negotiations was not only to cover the costs of collection, but also those of processing, as well as to put the centre on a profitable footing. Most of the negotiations therefore resulted in contracts stipulating one amount per pick-up point for collection and a separate amount for processing.

2. **Eliminate pick-ups in remote areas.** This recommendation is valid economically, but conflicts with Quebec's recycling objectives. In this connection, Gestion Gaudreau Inc. and the municipalities concerned should regard the reduction in the volumes of material landfilled as a direct benefit.

3. **Ensure that income from sales will cover expenses, by:**

   a) encouraging bottlers to provide more deposit containers;

   b) developing markets for recycled paper;

   c) reducing the centre's payroll by five persons.

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* Figure from the 1988 annual financial statement, $1.67 per pick-up point per year for the average for the 7 months covered in this study.

Unfortunately, the market for recycled materials is on the downswing, and is not likely to move up again before 1991. As far as the beverage bottlers are concerned, efforts have been made, and the volumes doubled in 1989.

The five jobs were in fact eliminated in November 1988, but to meet the demand, some employees have also been hired. The managers of the recycling centre might consider reassessing the productivity of these employees.

4. **Keep better track of tonnages, revenues, and expenditures for each type of material.** The scale that has now been installed should make it possible to keep better track of inventory.

5. **Improve safety at the centre.** The sorting area has been insulated and is now heated. Fire hoses have been installed at two locations, and workers are now required to wear safety goggles.

7.2 Comparison with Other Selective-collection Systems

Over the past few years, other selective-collection systems have been established throughout the province of Quebec. Some of these systems are public, others are private, but all have difficulty in generating enough revenue to cover expenses. Table 13 compares the system discussed in this report with two other systems; one is operated by a non-profit agency, Récupération Richmond-Wolfe, while the other, Recyclage Orford, is a private operation.

Table 13 Comparison of Three Recycling Organizations in Quebec

	Tri Gaudreau	Richmond-Wolfe	Recyclage Orford
Type of organization	private	non-profit	private
Area served	Bois-Francs (Arthabaska + 11 municipalities)	Asbestos + 9 municipalities	Ville LaSalle*
Population	58 100	3 000	78 000
Number of pick-up points	23 350	not available	30 000
Collection method	mixed	sort on truck	sort on truck
Sorting method	- semi-automated sorting - processing	- further sorting at centre - processing	- transfer centre, no sorting - processing
Materials recovered	white glass green glass newsprint mixed paper kraft bags aluminum metal food cans plastics	white glass white paper coloured paper newsprint thin cardboard cardboard kraft bags metal food cans	white glass green glass brown glass plastics metal food cans mixed paper cardboard
Annual tonnage	5 500 t	1 400 t (approx.)	2 000 t (approx.)
Revenue from municipalities	$9.50 per pick-up point per year	$7 per pick-up point per year	$7 per pick-up point per year

* Figures for Ville LaSalle; however, Recyclage Orford also serves Saint-Lambert, Notre-Dame-de-Grâce, and a drop-off point in Montreal.

Section 8

Environmental Analysis

8.1 Environmental Benefits

The numerous environmental benefits of recovering and recycling waste are obvious.

First of all, the Gaudreau recycling centre diverts 5 500 tonnes of recyclable materials from the landfill each year. This tonnage represents approximately 44 000 m^3 of waste. A landfill that has the capacity to receive the amount of waste generated by the region considered in this study -- 26 600 tonnes per year -- and a service life of 30 years, will have its service life extended by eight years. This is a considerable savings, compared with the cost of opening or enlarging such a site. The experiment in the Bellevue district has shown that it is possible to reduce the amount of waste sent to the landfill even further by optimizing collection methods and separating compostable wastes. For the region considered in this study, every additional 5% reduction in waste represents 1 335 tonnes and 11 000 m^3 of material, and two more years of service from the landfill site.

8.2 Energy Savings

From the standpoint of energy savings, less energy is used when products are manufactured from recycled materials versus virgin materials. Table 14 shows the amount of energy saved through the use of materials recovered by the centre in 1989. These figures are only estimates. Various authors (Rahn, 1987 and Wilson, 1981) present different values, depending on the processes and the production steps used in the calculation.

Table 14 shows that the total amount of energy saved through the use of materials recovered by the centre is 60 743 gigajoules each year -- the equivalent of 10 000 barrels of oil. This is an impressive figure, considering that the population involved is 58 000 people and the participation rate is 70%.

Table 14 Energy Saved Through the Use of Materials Recovered by the Centre

Material	Percentage (%)	(t)	Energy per tonne* (GJ/t)	Total energy (GJ)
Paper	69.8	3 839	12	46 068
Aluminum	0.7	38	270	10 260
Metal Food Cans	1.0	55	15	825
Plastic	2.1	116	25	2 900
Glass	25.1	1 380	5	690
Other	1.3	72	---	---
Total	100	5 500	---	60 743

* Rahn, 1987 and Wilson, 1981

Section 9

Conclusion and Recommendations

The purpose of this study has been to assess the actual improvements and the effects on profitability that have resulted from installing new equipment at the Gaudreau recycling centre. This study has also included a description of the system and the environmental benefits of the centre.

All the equipment covered by the present project has now been installed.

In 1988, the sorting was done partly on the collection trucks and partly at the recycling centre. In 1989, the equipment and methods used to collect recyclables were changed. All sorting is now done at the recycling centre. This change has altered the distribution of costs; the costs of collection have decreased, while those of processing at the centre have increased. If we exclude the expenses related to the changes at the centre, the total costs of collection and processing remained about the same from 1988 to 1989. Since the new equipment is still in its shakedown period and the centre is therefore not operating at peak capacity, the total cost of the collection and processing operations should not increase in the short term. However, slight increases, proportional to inflation, can be expected in the medium term.

The changes at the centre have thus enabled it to stabilize its operating costs. The new, mixed-collection method has thus had a positive financial impact and can therefore contribute to the centre's profitability. But because revenues are declining, it is currently impossible to run this business at a profit. The municipalities will therefore have to recognize the economic and environmental benefits of the centre's activities and pay an amount per pick-up point in addition to that which they pay now (an average of $9.50 per pick-up point per year).

This amount will have to be paid separately for collection and processing, because these operations are now conducted by two different companies. The amounts per pick-up point per year would be approximately $12 to $13 (total) for collection and $4 to $7 (depending on the market) for processing, or $16 to $20 for the two combined. These amounts assume proper rationalization of expenses and a small margin of profit of 5 to 10% on sales revenues, excluding the amount invested. The Quebec environment ministry's policy on the integrated management of solid wastes (MENVIQ, 1989) calls for amounts of $12 to $15 per pick-up point per year.

If recycling centres like the one described in this report are to be established anywhere else, the co-operation of government will be needed to cover capital costs and protect residents from operating expenses.

The advantages of a mixed-collection system of the kind described in this report are as follows:

- A mixed-collection system lets municipalities put the job of collecting recyclables out to tender. Most waste-collection firms are capable of collecting recyclables as long as they do not have to sort them.

- The recycling centre can be independent from the collection operation. It can be established and operated through various types of co-operative arrangements between the municipality and the private sector.

- The job of sorting recyclables is made as easy as possible for the consumer.

- The system is flexible. The collection and sorting methods discussed in this report can be adapted to handle new recoverable materials without any costly modifications or any changes in residents' habits.

The main recommendations of this study are to:

1. Continue and expand the experiment in the Bellevue district.

2. Install the receiving pit, which was not provided for in the current project. However, this depends on recommendation 6, which would require an additional study to measure the actual effect of this move.

3. Emphasize recovery of fine paper from businesses.

4. Devise methods of monitoring productivity so as to optimize the centre and reduce or stabilize its operating costs.

5. Get involved in converting recovered materials into marketable products, either alone or in partnership with a manufacturing firm.

6. Obtain financial support from the municipalities to ensure the business's survival. The amount required per pick-up point per year should total between $16 and $20 for collection and sorting combined.

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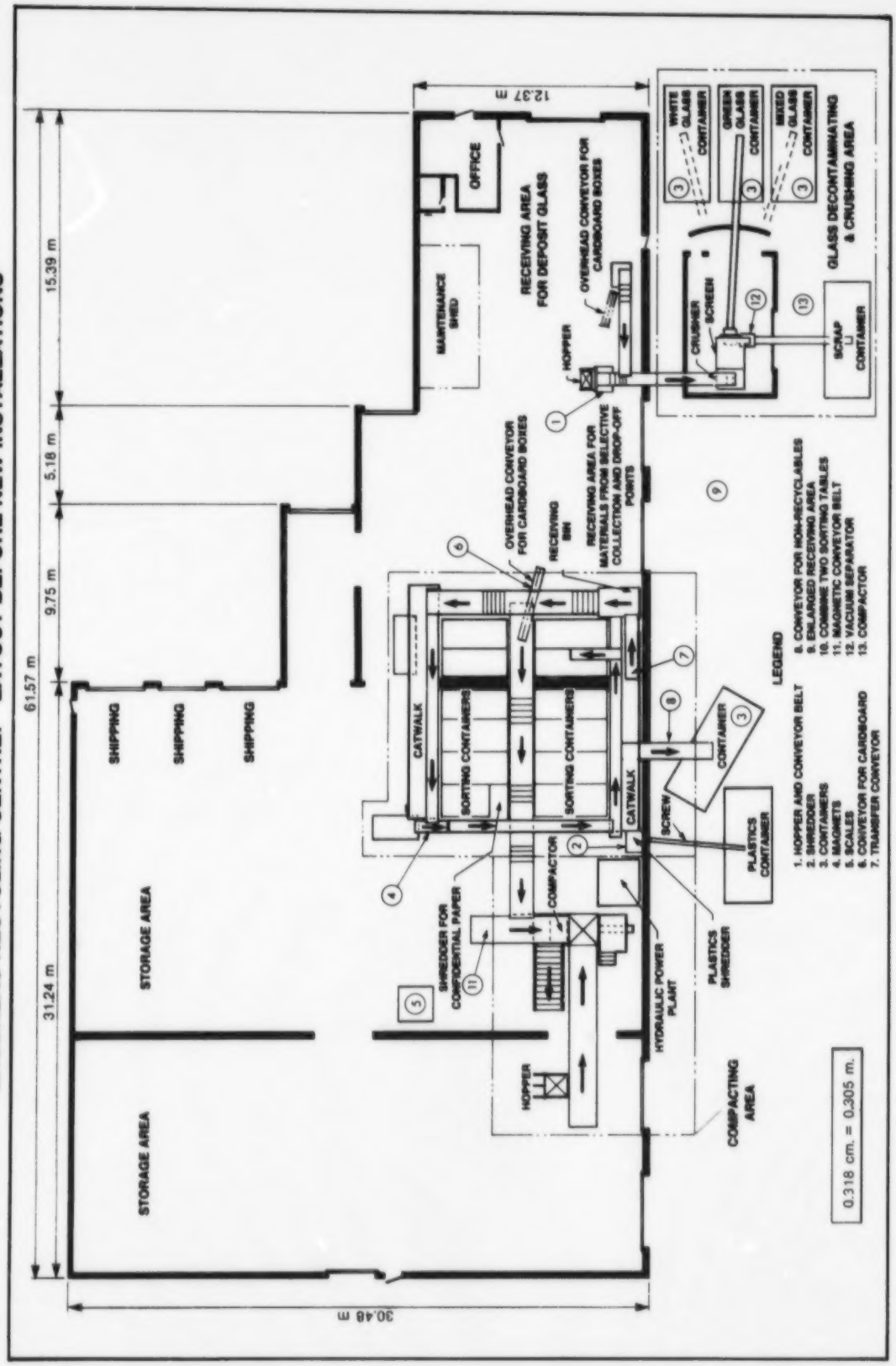
Appendix

Drawings

- **Layout before new installations**
- **Layout after new installations**

GAUDREAU RECYCLING CENTRE: LAYOUT BEFORE NEW INSTALLATIONS



GAUDREAU RECYCLING CENTRE: LAYOUT AFTER NEW INSTALLATIONS